and 11 inches at Omaha, Nebr. On the 22d there were 6 inches at Albany, N. Y.; 20 inches at St. Paul, Minn.; none at Dubuque and Davenport, Iowa; 15 inches at La Crosse, Wis.; 28 inches at Williston, N. Dak.; 23 inches at Yankton, S. Dak.; 7.5 inches at Omaha, Nebr. On the 29th the reported thickness of ice in inches was as follows:

Hudson River.—Albany, N. Y., 8.

Upper Mississippi River.—St. Paul, Minn., 20.5; La Crosse, Wis., 22; Dubuque, Iowa, 10; Davenport, Iowa, 8; Keokuk, Iowa, 7.5; Hannibal, Mo., 8.

Upper Missouri River.—Williston, N. Dak., 24; Bismarck, N. Dak., 30; Pierre, S. Dak., 25; Yankton, S. Dak., 21; Sioux City, Iowa, 18; Omaha, Nebr., 15; Kansas City, Mo., 6.

Platte River.—North Platte, Nebr., 16.

Lake Superior.—Duluth, Minn., 21; Sault Ste. Marie, Mich., 19.

Lake Michigan.—Green Bay, Wis., 18; Chicago, Ill., 5; Grand Haven, Mich., 2.

Lake Huron.—Alpena, Mich., 4.

Lake Erie.—Toledo, Ohio, 4; Sandusky, Ohio, 4.5; Cleveland, Ohio, 3; Erie, Pa., 2.5; Buffalo, N. Y., 2.

Lake Ontario.—Oswego, N. Y., 4.

The following special reports have also been collected:

Allegany River.—Pittsburg, Pa., 27th to 31st, floating ice.

Detroit River.—Detroit, Mich., 7th and 8th, closed by ice in morning, but soon opened by ferry boats.

Hudson River.—Albany, N. Y., 1st, floating ice; 3d, frozen from shore to shore.

Mississippi River.—Dubuque, Iowa, 8th, frozen over; 17th, channel partly open, but full of floating ice; 18th, only a small quantity of floating ice; 21st, open at Eagle Point, a few miles north, and in front of this place below the bridge; 22d; open from Eagle Point to this place; 24th, again frozen. Fort Madison, Iowa, 23d, frozen during the night. Hannibal, Mo., 25th, frozen. Le Claire, Iowa, 20th, ice broken up; 22d, frozen again.

Missouri River.—Hermann, Mo., 8th and 10th, floating ice; 11th, gorged; 24th, heavy floating ice; 25th, frozen.

Ohio River.—Marietta, Ohio, 28th to 31st, floating ice. Parkersburg, W. Va., 29th to 31st, running ice. Wheeling, W. Va., 13th, floating ice; 27th to 31st, floating ice.

Lake Erie.—Cleveland, Ohio, 12th, 25th to 31st, floating ice.

Lake Huron.—Port Huron, Mich., 1st to 12th, 24th, 25th, 30th, and 31st, floating ice; 25th, the Black River frozen over.

Lake Superior.—Marquette, Mich., 25th, harbor frozen over.

Wisconsin.—Rock River, ice 11 inches thick. Rock Lake, ice 14 inches thick. Hartford, ice 14 inches thick, the ground frozen 4 inches deep.

Minnesota.—Excel, Thief River, at the end of the month, ice 28 inches thick. Minneapolis, ice 22 inches thick on the lake. Marfield, ice 30 inches thick on lakes and ponds. Blooming Prairie, ice 2 feet thick on Cedar River; Willmar, ice 28 inches thick on lakes.

OBSERVATIONS ON THE GREAT LAKES.

Owing to the closing of navigation on the Great Lakes during the winter season the Weather Bureau has received reports for the month of January from no vessels and from only 10 U. S. Life-Saving stations.

SURFACE CURRENTS.

The collection of floating bottles for the determination of currents is necessarily interfered with by the presence of ice, but the drift of the ice itself should be noted by those interested in this class of observations. A discussion by Prof. M. W. Harrington of the results of the work done by the Weather Bureau in 1892 and 1893 has been published in an official circular, Bulletin B, from which the following extracts are taken:

The investigations of this paper relate to the season of navigation and the currents that appear on the maps are practically the currents of the summer season. It is entirely possible that the currents of the other seasons would show some variations.

A. The Lakes all have an outflow, and there must be a general motion of the water toward this outflow; the speed of this body current is very slight.

B. The winds have a great effect on the currents, and the most frequent winds on the Great Lakes are shown in the proper tables, from which it appears that 30 per cent are from the southwest, 22 per cent from the west, 14 per cent from the northwest, 10 per cent from the northeast, 14 per cent from the south, 5 per cent from the southeast, 3 per cent from the north, and 1 per cent from the east. The general resultant wind during the summer months is westerly, but at a few stations it is easterly.

C. The return currents.—It will be observed that, in the case of three of the lakes, the main currents hug one shore. In the case of Lake Superior, it is the southern shore; in the case of Lake Michigan, it is the eastern shore; and in that of Lake Huron, it is the western shore. In the case of Lake Erie and Lake Ontario this phenomenon does not appear so plainly. This feature can be explained by the two sorts of currents already mentioned, combined with the lay of the lakes, as to the prevailing direction of the wind and the position of the outlet. In the case of Lake Superior the outlet is on the southern side. In the case of Lake Michigan the readiest access to the outlet is along the eastern shore, the access from other directions being barred by the group of islands near the northern end of the lake. In the case of Lake Huron the outlet is on the western side, as are also the inlets of the lake.

In any case the drive of the water from one end of the lake to the other necessitates more or less a return current, providing the outlet is not sufficiently large to allow this water to pass through. In the Great Lakes the outlets are relatively small, so that in all these cases there must be return currents. Such currents will combine with the direct ones to make a large general whirl in the lake if the latter is sufficiently broad (lakes Superior and Huron), or lies across the wind (lakes Huron and Michigan). If the lake has its long axis in the direction of the wind (lakes Erie and Ontario), the return currents will break up into smaller whirls along the great pockets of the coast on either side of the general current. Around groups of islands a smaller return current, or a distinct swirl, will be set up. All these cases are illustrated in the detailed discussion which follows.

D. Surf motion.—A wave which is not breaking does not necessarily carry forward a body floating on its surface, but so soon as it breaks, the surf on the crest of the wave will carry with it any body which happens to be floating in it. The result of this is that while a body is outside of the surf it is carried on by the general drift of the water. So soon as it comes within the surf it advances more or less rapidly in the direction in which the surf is moving. Now, the surf occurs generally in shallow water and seeks the shore. Therefore, the bottle papers will be found to have a decided tendency shoreward whenever they come within its vicinity, and especially so when the water is shallow. This may be the general shore, or it may be the shore of islands within the lake. Moreover, there is a very curious phenomenon occasionally appearing on the maps, which can also be accounted for by this surf motion. This is the tendency of the bottles to pass into deep bays and along their length, and to be lodged on the shore somewhere near the bottom of the bay. This is undoubtedly due to surf motion. Generally speaking, the waves in these long bays move up the bay, and have more or less surf. The body floating on them will also move up the bay, and its tendency will be to pass up the entire length of the bay, or nearly so.

The attention of the Weather Bureau will be directed in the season of 1894 more especially to the recovery of the bottles which have been floated but not yet found. It appears, as already stated, that probably not 10 per cent of the bottles have been recovered. It will be comparatively easy to search the shores with reference to recovering others, and it is hoped that a large number can be added to throw further light on the character of the currents of the Great Lakes. Navigators of the Lakes, fishermen, residents on the shores, and others who have occasion to visit the shore are earnestly requested to make every effort to recover what bottles are lying there, and to return to the Weather Bureau the inclosed paper, with the proper memoranda.

SUNSHINE AND CLOUDINESS.

The quantity of sunshine received by the atmosphere above the cloud layer, on any given day or month, is constant from year to year, and the heat attending this sunshine is sensibly constant, although there are some indications of a barely appreciable variation in this heat associated with the condition of the sun's surface. On the other hand, at the surface of the earth the distribution of sunshine (and therefore, of the resulting heat, ascending currents of air, winds, evapora-